SENIOR HIGH MATHEMATICS

MATHEMATICS 14-24

PROGRAM OF STUDIES

IMPLEMENTATION - SEPTEMBER 1990

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MATHEMATICS 14-24

A. PROGRAM RATIONALE AND PHILOSOPHY

To set goals and make informed choices, students need an array of thinking and problem-solving skills. Fundamental to this is an understanding of mathematical techniques and processes that will enable them to apply the basic skills necessary to address everyday mathematical situations, as well as acquire higher order skills in logical analysis and methods for making valid inferences.

A knowledge of mathematics is essential for a well-educated citizenry. However, the need for and use of mathematics in the life of the average citizen is changing. Emphasis has shifted from the memorization of mathematical formulae and algorithms toward a more dynamic view of mathematics as a precise language, used to reason, interpret and explore. There continues to be a need for the logical development of concepts and skills as a basis for the appropriate use of mathematical information to solve problems. Moreover, the use of available technology along with techniques such as estimation and simulation, incorporated with more traditional problem-solving techniques, are the tools with which mathematical problems are solved.

Change in the way in which mathematics is used is necessitating a concurrent change in the emphases of mathematics education. Students need an expanded list of fundamental concepts but will also need to understand the ideas that make up those concepts and how they are related. They also require familiarity with their applications. Most important, students have to be able to solve problems using the mathematical processes developed, and be confident in their ability to apply known mathematical skills and concepts in the acquisition of new mathematical knowledge. In addition, the ability of technology to provide quick and accurate computation and manipulation, to enhance conceptual understanding and to facilitate higher order thinking, should be recognized and used by students.

The majority of students who enter senior high school exhibit mainly concrete operational behaviours with regard to mathematics. It is recognized that senior high school mathematics courses include many abstract understandings which students are expected to acquire. The course content of the Senior High School Mathematics Program is cognitively appropriate for the students and should be presented in a way that is consistent with the students' ability to understand.

The Senior High School Mathematics Program, includes the course sequences Mathematics 16-26, 14-24, 13-23-33 and 10-20-30, plus Mathematics 31. Transfer by students among courses of different sequences is possible. The course sequences commensurate with differing abilities, interests and aspirations, are designed to enable students to have success in mathematics. As well, the mathematics program reflects the changing needs of society, and provides students with the mathematical concepts, skills and attitudes necessary to cope with the challenges of the future.

The Mathematics 14-24 sequence is designed for students whose needs, interests and abilities focus on basic mathematical understanding. The emphasis is on the acquisition of practical life skills and students are provided with opportunities to improve their skills in working with mathematics. Students who successfully complete Mathematics 24 may choose to enter directly into a job or select from a limited number of trade programs. The mathematics requirement for the General High School Diploma consists of two courses in Mathematics; e.g., Mathematics 14 and Mathematics 24.

B. GENERAL LEARNER EXPECTATIONS

Upon conclusion of their senior high mathematics education, students will be expected to be mathematically literate. **Mathematical literacy** refers to students' ability and inclination to manage the demands of their world through the use of mathematical concepts and procedures to communicate, reason, and solve problems. More specifically, *students will be expected to:*

- have achieved understanding of the basic mathematical concepts, and developed the skills and attitudes needed to become responsible and contributing members of society
- apply basic mathematical skills and concepts in practical situations
- have developed the skills, concepts and attitudes that will ensure success in the mathematical situations that occur in future educational endeavours, employment and everyday life
- have developed the skills, concepts and attitudes that will enable the acquisition of mathematical knowledge beyond the conclusion of secondary education
- have developed critical and creative thinking skills
- be able to communicate mathematical ideas effectively
- understand how mathematics can be used to investigate, interpret and make decisions in human affairs
- understand how mathematics can be used in the analysis of natural phenomena
- understand the connections and interplay among various mathematical concepts and between mathematics and other disciplines
- understand and appreciate the positive contributions of mathematics, as a science and as an art, to civilization and culture.

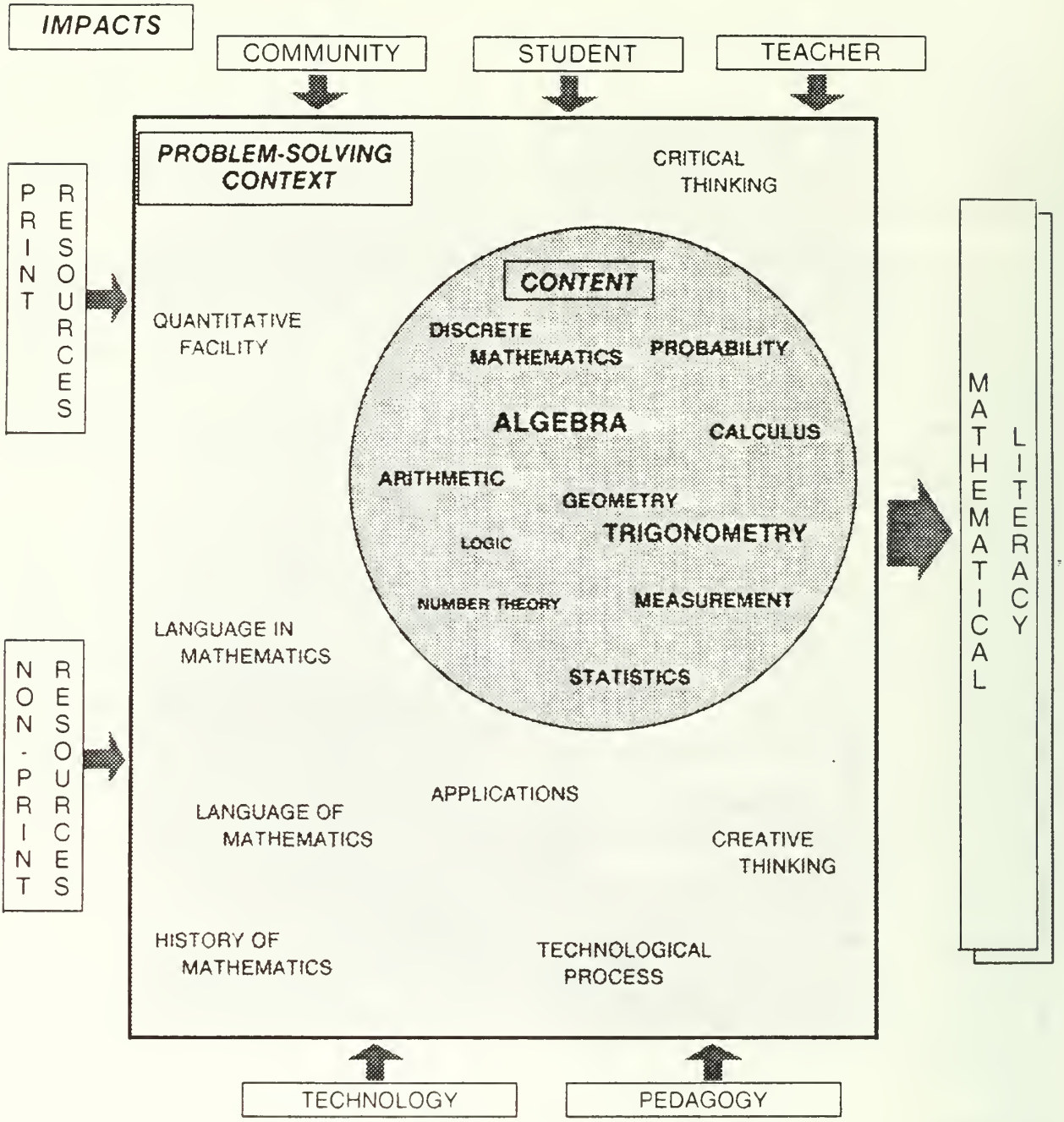
A General Model for **Mathematical Literacy** for Senior High School Programs is presented on the following page which outlines the factors that affect what and how students learn as they become mathematically literate. The model is fluid in that the content can be learned within a problem-solving context which engages any of a number of vehicles as the learning focus. At the same time, the students involved in the learning situation are affected in what and how they learn by forces that have impact upon them.

The **Content** of the Senior High School Mathematics Program is the body of knowledge that is to be acquired by students. In the various senior high school mathematics courses, it is made up of topics that can be categorized into one or more of the listed strands.

Within each course in the Senior High School Mathematics Program, students will focus on problem solving. The **Problem-Solving Context** refers to the instructional emphases within which the specific content expectations can be acquired. The various entries indicated within the model suggest processes that belong to the problem-solving context and may be used by students as vehicles for learning the content.

The **Impacts** on the problem-solving context are those skills, attitudes and experiences that are possessed by the students and teachers involved, as well as the resources they may use throughout the learning process. They include the influence exerted by the culture and beliefs of the community as reflected by the school. The effectiveness of the context in enabling a student to acquire the content is dependent upon the skilful management by the teacher of those items that impact upon a student's learning.

A General Model for Mathematical Literacy for Senior High School Programs



C. SPECIFIC LEARNER EXPECTATIONS

Program Organization

The major part of the content of each senior high school mathematics course consists of topics required of all students who take the course. The required content comprises 80% of the course and contains the concepts, skills and attitudes that all students are expected to acquire. As well, the required portion of all courses includes specific expectations in regard to problem solving and the use of technology.

Each course includes a compulsory component comprising 20% of the course, made up of elective material which is consistent with the content and expectations of the required component. The purpose of the elective is to provide for enrichment, remediation, or innovative or experimental presentations or activities. It is not intended to provide acceleration or advanced placement. However, horizontal enrichment and extension is appropriate and students should have access to elective material that serves their individual needs and interests.

Mathematics 14 is a five-credit course. Mathematics 24 is a three- or a five-credit course organized into twelve units within five themes. It is important that teachers address each of the five themes as well as provide for the specific needs of their individual classes. The required component of Mathematics 24 courses offered for three credits will be made up of attitudes, problem solving, numeration, and geometry and measurement as well as six units, including one unit from each of the five themes, plus any one other unit selected from any of the themes, chosen according to the needs and interests of the students in the class. The required component of Mathematics 24 courses offered for five credits will be made up of attitudes, problem solving, numeration, and geometry and measurement as well as ten units, including one unit from each of the five themes, plus any five other units chosen from any of the themes. The elective component in Mathematics 24 for three or five credits will be in addition to the above. The elective component may include any units not used in the required component, chosen according to the needs and interests of the students in the class.

The themes and the units within them are:

WORK
- Income
- Income Tax

BANKING
- Personal Banking
- Consumer Credit

TRANSPORTATION
- Purchasing a Vehicle
- Operating a Vehicle
- Travelling

ACCOMMODATION
- Renting and Purchasing a Home
- Mortgage and Household Insurance
- Building, Decorating and Furnishing

COST OF INDEPENDENCE
- Budgets and Getting Value for Money Spent
- Life and Health Insurance

Evaluation of students in the Senior High School Mathematics Program will involve assessment of the level of achievement of all of the learner expectations, including concepts, skills and attitudes, as well as problem solving and technological expectations. For more information regarding evaluation, consult the *Teacher Resource Manual for Senior High Mathematics.*

Program Structure

At the beginning of each course is a list of attitude expectations. These attitudes embody a mathematical attitude or frame of mind for a student to view the world. The attitude expectations should be woven into the fabric of the entire course.

Following this are the problem-solving expectations that outline a variety of procedures, strategies, skills and checking techniques for solving problems. Because a major purpose for

studying mathematics is to learn to solve problems, problem-solving expectations occur throughout all areas of the specific learner expectations. Students must have the background skills and knowledge necessary to achieve these expectations successfully, using problem-solving techniques.

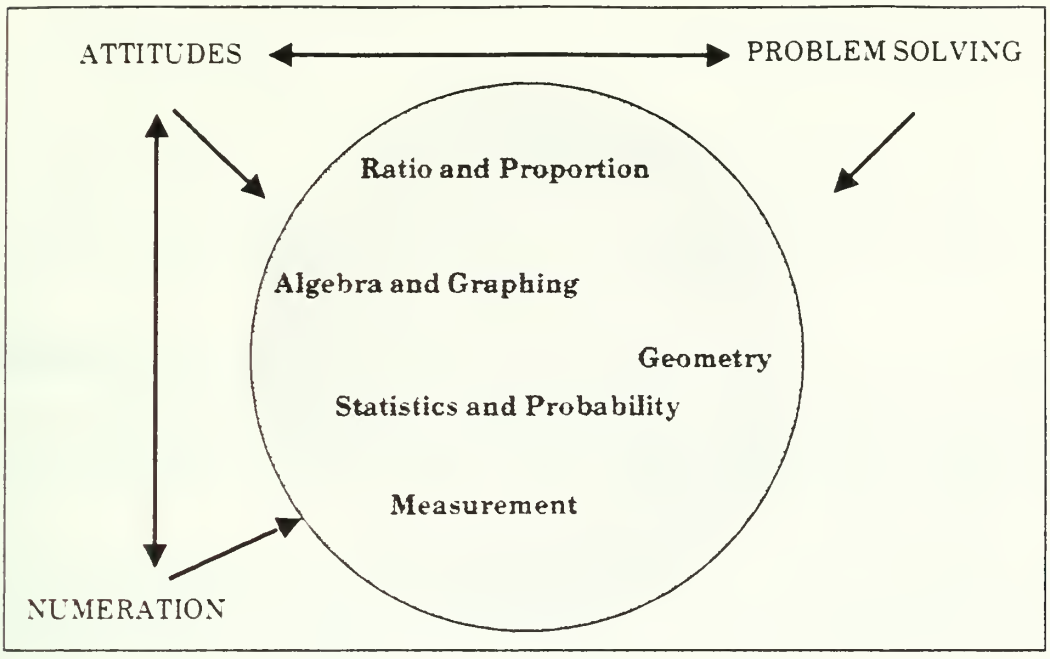
The units of the course are broken into a number of concepts. A concept is an abstract or general idea about specific instances that have common properties or an identifiable relationship to one another. The concepts are presented as mathematical definitions or theorems or as statements of mathematical ideas or abstractions. In the course of studies, concepts are stated as "*Students will be expected to* demonstrate an understanding that . . ."

Supporting each concept are a number of skills. Skills are intellectual or physical capabilities that will be developed within the context of the particular concept. In the course of studies, skills are stated as "*Students will be expected to* . . ."

Skills specifically related to the use of technology identify areas in which calculators and/or computer technology are applied by students as tools to be used for calculations, manipulation or graphing, or to aid in the analysis of problems. Technological expectations are defined explicitly throughout the learner expectations. In many cases, a particular technology is indicated for investigation or analysis. It is in these situations that the use of technology enables students to engage in critical and creative thinking and problem solving.

Students will be expected to learn how and when to use a calculator and have a demonstrated proficiency in estimation and mental arithmetic. To use calculators effectively, they must be able to judge the reasonableness of an answer and understand the importance of making a judgment about the result of a calculation.

Mathematics 14 Program Structure



Attitudes

1. *Students will be expected to* demonstrate an attitude associated with mathematical literacy. In particular, students will be expected to:

   1.1 be confident in their mathematical knowledge and in their ability to acquire new knowledge
   1.2 demonstrate persistence, resolve, flexibility and ingenuity in finding the solution to problems
   1.3 develop intellectual curiosity and openness to new ideas, insights and change in the pursuit of mathematical knowledge
   1.4 exhibit an attitude of curiosity and spontaneity and appreciate creativity and innovation in representing situations mathematically
   1.5 be critical and constructive in approaching new ideas and new processes
   1.6 be aware of the importance of communication skills in mathematics
   1.7 appreciate the usefulness of computational competence, mathematical processes and problem-solving skills which are used in the decision-making and modeling processes in our society
   1.8 appreciate the contributions of mathematics to our culture and civilization.

Problem Solving

1. *Students will be expected to* demonstrate an understanding of the variety of procedures that can be used to understand problems. In particular, students will be expected to:

1.1 read the problem thoroughly
1.2 identify and clarify key components
1.3 restate the problem, using familiar terms
1.4 evaluate the given information as to sufficiency and relevancy
1.5 interpret pictures, charts and graphs
1.6 determine hidden assumptions
1.7 ask relevant questions
1.8 identify given, needed and wanted information
1.9 diagram or model the problem situation
1.10 use suitable notation
1.11 determine valid inferences
1.12 simulate a problem situation
1.13 formulate situations into identifiable problems.

2. *Students will be expected to* develop a variety of strategies for use in the solution of mathematical problems. In particular, students will be expected to:

2.1 conduct an investigation
2.2 use estimation and approximation
2.3 develop equations or use formulae
2.4 use flow charts
2.5 make lists and charts
2.6 look for patterns
2.7 work backward
2.8 break the problem into smaller parts
2.9 look for a simpler or related problem
2.10 make diagrams or models
2.11 use manipulatives
2.12 choose and sequence a series of mathematical operations
2.13 sketch the graph of a problem situation
2.14 establish procedures to gather and organize data
2.15 apply empirical or inductive processes
2.16 use geometric construction and measurement techniques
2.17 make and test a conjecture.

3. *Students will be expected to* develop a variety of skills which can be used to carry out the plan for the solution of a problem. In particular, students will be expected to:

3.1 apply selected strategies
3.2 present ideas clearly
3.3 document the solution process
3.4 use appropriate group behaviours
3.5 use calculators and computers
3.6 evaluate problem-solving strategies for effectiveness
3.7 alter or abandon non-productive strategies
3.8 search for additional information
3.9 ask questions
3.10 be open to inspirations, intuitions and "bright ideas".

4. *Students will be expected to* employ a variety of skills to help them look back over the solution of a problem. In particular, students will be expected to:

   4.1 determine the reasonableness of an answer
   4.2 explain the solution in oral or written form
   4.3 consider the possibility of additional solutions
   4.4 search for other strategies and processes of solution
   4.5 create and solve similar problems
   4.6 note the characteristics that will be identifiable in similar problems
   4.7 make a generalization
   4.8 examine the assumptions made and simplifications and modifications used for accuracy, effectiveness and efficiency.

Numeration

Numeration concepts and calculation skills are basic in order to address successfully any mathematical situation. Since it is the intent to integrate the development of these concepts and skills into the other expectations of this course, it is not expected that numeration will be taught as a topic on its own.

1. *Students will be expected to* demonstrate an understanding that computation requires skills in addition, subtraction, multiplication and division with whole numbers, integers and rational numbers and can be done mentally, with paper and pencil, and with electronic calculators, as appropriate to a particular situation.

   Mental Computation

   Students will be expected to:

   1.1 add and subtract whole numbers, integers and rational numbers (limit: add three single-digit integers; subtract two single-digit integers; add and subtract two multiples of 5 and 10 up to 100; add and subtract fractions with common denominators; add and subtract tenths and hundredths written in decimal form)
   1.2 multiply whole numbers, integers and rational numbers (limit: single-digit numbers, multiples of 5 and 10 multiplied by a single-digit multiplier; double any number up to 50; multiply whole numbers, integers and decimals by powers of 10)
   1.3 square integers up to 10 and calculate square roots of integral perfect squares up to 100
   1.4 divide whole numbers, integers and rational numbers (limit: divide integers to 100 which are perfect multiples of single-digit divisors; halve even integers to 50; divide whole numbers, integers and decimals by powers of 10)
   1.5 determine whether a whole number or integer is divisible by 2, 3, 4, 5 or 10
   1.6 transform fractions to percents (limit: denominators of 2, 3, 4, 5, 10, 100) and whole number percents
   1.7 calculate the percent of given whole number quantities (limit: 1%, 10%, 25%, 50%, 100%, 200%)
   1.8 recognize "families" of fractions (tenths, twelfths, sixteenths) and transform fractions within families to common denominators.

Paper and Pencil Computation

Students will be expected to:

1.9 add and subtract whole numbers, integers and rational numbers (limit: add three 2-digit integers; subtract 3-digit integers; add and subtract two fractions with denominators of 2, 3, 4, 5, 6, 8, 10, 16; add three 2-digit decimals; subtract 2-digit decimals)
1.10 multiply whole numbers, integers and rational numbers (limit: 2-digit integers, 2-digit decimals, fractions with single-digit denominators and denominators which are multiples of 10)
1.11 divide whole numbers, integers and rational numbers (limit: 3-digit integers which are perfect multiples of single-digit divisors; halve even numbers up to 500)
1.12 calculate the percent of given quantities (limit: 5%, 15%, 25% and multiples of 10%)
1.13 calculate the value of a power (limit: whole number base <10 and exponent of 2 or 3)
1.14 transform mixed numbers to decimals and percents (limit: denominators of 2, 3, 4, 5, 6, 8, 10).

Calculation with Calculators

Students will be expected to:

1.15 calculate the percent of given quantities
1.16 calculate the value of a power (limit: integral base and whole number exponent)
1.17 calculate the square root of any positive rational number
1.18 transform any rational number to decimal and percent form.

2. *Students will be expected to* demonstrate an understanding that rounding, estimation and approximation are fundamental to facility in calculation.

Students will be expected to:

2.1 round given values to a specified level of precision
2.2 round solutions to an appropriate level of precision
2.3 use estimation techniques to predict solutions to calculations.

3. *Students will be expected to* demonstrate an understanding that checking an answer for reasonableness and accuracy is a fundamental step in the calculation process and that the level of accuracy required is dependent upon the particular situation.

Students will be expected to:

3.1 use estimation techniques to check a calculation for reasonableness
3.2 determine if the accuracy of a calculated answer is adequate for a given situation.

Ratio and Proportion

1. *Students will be expected to* demonstrate an understanding that a ratio is a way of comparing the relative sizes of two quantities.

Students will be expected to:

1.1 compare two quantities using ratios in the form $\frac{a}{b}$, a:b, and a to b.

2. *Students will be expected to* demonstrate an understanding that a rate is a ratio between quantities that have different units.

   Students will be expected to:

   2.1 calculate rates and unit rates

      2.1.1 solve problems involving the use of rates and unit rates.

3. *Students will be expected to* demonstrate an understanding that proportions are equations made up of equivalent ratios.

   Students will be expected to:

   3.1 calculate the unknown value in a proportion

      3.1.1 solve problems using proportions.

4. *Students will be expected to* demonstrate an understanding that a percent is a ratio in which a quantity is compared to 100.

   Students will be expected to:

   4.1 express ratios as percents and decimals and vice-versa
   4.2 solve for the unknown element in a percentage calculation

      4.2.1 solve problems that involve the use of percents.

Statistics and Probability

1. *Students will be expected to* demonstrate an understanding that data collected from a sample must be organized, presented and analyzed in order that valid inferences can be drawn.

   Students will be expected to:

   1.1 use the terms sample and population
   1.2 determine a suitable sample from a given population

      1.2.1 assess the suitability of a sample chosen from a given population

   1.3 organize data using tally sheets, frequency tables and stem-and-leaf plots

      1.3.1 design and carry out a simple statistical project involving the collection, organization, presentation and analysis of data gathered from an appropriate sample

   1.4 interpret and analyze data represented by pictographs, circle graphs, bar graphs, line graphs, and histograms
   1.5 identify the characteristics of a misleading graphical display
   1.6 determine and calculate appropriate measures of central tendency

      1.6.1 solve problems that involve the use of an appropriate measure of central tendency in the analysis of sets of data

   1.7 make inferences and generalizations about a population from which a sample was taken.

2. *Students will be expected to* demonstrate an understanding that a probability is a numerical measure of the likelihood of an event and can take values from 0 through 1.

Students will be expected to:

2.1 list the sample spaces for simple experiments or simulations
2.2 use counting techniques such as tree diagrams to find the number of possible outcomes of an experiment
2.3 express the probability of an event from a given situation, simple experiment or simulation

2.3.1 perform an investigation to find the experimental probability of an event.

Geometry

1. *Students will be expected to* demonstrate an understanding that two- and three-dimensional geometric figures can be classified and have characteristics that uniquely define them.

Students will be expected to:

1.1 classify polygons according to the number of sides
1.2 classify triangles and quadrilaterals by sides and angles
1.3 determine the sum of the interior angles of a polygon

1.3.1 perform an investigation to determine the sum of the interior angles of any polygon

1.4 classify the following common geometric solids: rectangular prisms, pyramids, cylinders, cones and spheres

1.4.1 perform an investigation to determine the relationship amongst the edges, faces and vertices of polyhedra
1.4.2 draw nets which define simple polyhedra
1.4.3 use nets to construct simple polyhedra

1.5 identify and define the following terms associated with a circle; such as radius, diameter, circumference, semicircle.

2. *Students will be expected to* demonstrate an understanding that geometric figures can be defined uniquely and that these unique characteristics can be reproduced using construction techniques and geometric instruments.

Students will be expected to:

2.1 construct a line segment of given length or congruent to a given segment
2.2 draw an angle of a given size or construct an angle congruent to a given angle
2.3 construct the perpendicular bisectors of segments and angles
2.4 draw regular polygons
2.5 construct a circle of given radius
2.6 use a combination of construction techniques

2.6.1 construct angles of 90°, 45°, 60° and 30°
2.6.2 use construction techniques in the construction or reproduction of geometric figures or designs.

3. *Students will be expected to* demonstrate an understanding that similar geometric figures have the same shape but may differ in size. that corresponding angles are equal, and that the lengths of corresponding sides are proportional.

   Students will be expected to:

   3.1 use the relationship between the lengths of the sides of similar triangles to calculate the lengths of unknown sides

      3.1.1 solve problems using the properties of similar polygons

   3.2 recognize congruency as similarity in which the size of the figures is the same.

4. *Students will be expected to* demonstrate an understanding of the Pythagorean theorem.

   Students will be expected to:

   4.1 use the Pythagorean theorem to find the length of a side in a right triangle

      4.1.1 solve problems involving right triangles by using the Pythagorean theorem.

5. *Students will be expected to* demonstrate an understanding that angles formed by intersecting lines relate to each other.

   Students will be expected to:

   5.1 identify parallel, intersecting and perpendicular lines
   5.2 identify and recognize the characteristics of the relationship between supplementary, complementary and vertical angles

      5.2.1 perform an investigation to determine the properties of the angles between intersecting lines
      5.2.2 solve problems involving the relationships amongst intersecting and parallel lines and the angles they form to solve problems involving the measure of unknown angles.

Measurement

1. *Students will be expected to* demonstrate an understanding that standard units of measure for length, mass, and volume provide consistency and accuracy and that the most widely used and accepted measurement system is the SI (metric) system.

   Students will be expected to:

   1.1 recognize the basic SI units of measurement for length (metre (m)), mass (kilogram (kg)), (tonne (t)), and volume of liquids or gases (litre (L))
   1.2 use the appropriate SI measures for length. mass and liquid/gas volume (limit: kg, g, L, mL, m, cm, mm, km)
   1.3 express equivalences between units of length, of mass and of volume
   1.4 recognize non-metric units of measurement still in common use.

2. *Students will be expected to* demonstrate an understanding that perimeter is the measure of the distance around a geometric figure.

   Students will be expected to:

   2.1 calculate the perimeter of polygons

      2.1.1 calculate the perimeter of irregular shapes and objects

   2.2 calculate the circumference of a circle by using a formula

      2.2.1 solve problems that involve finding the circumference of circles and circular regions.

3. *Students will be expected to* demonstrate an understanding that area is the number of unit squares which are enclosed within the boundaries of a geometric figure.

   Students will be expected to:

   3.1 calculate the area of triangles and quadrilaterals by using formulas (limit: triangles, quadrilaterals)

      3.1.1 solve problems that involve finding the area of triangles and rectangles

   3.2 find the area of a circle by using a formula

      3.2.1 solve problems that involve finding the area of circles.

4. *Students will be expected to* demonstrate an understanding that volume is the number of unit cubes which are within a geometric solid.

   Students will be expected to:

   4.1 calculate the volume of rectangular prisms and cylinders by using formulas

      4.1.1 solve problems that involve calculating the volume of rectangular prisms and cylinders.

5. *Students will be expected to* demonstrate an understanding that time can be measured in seconds, minutes, hours, days, weeks, months and years.

   Students will be expected to:

   5.1 change units of time from one form to another
   5.2 tell time, using a 24-hour clock
   5.3 write times using proper 24-hour notation
   5.4 perform calculations, using units of time.

6. *Students will be expected to* demonstrate an understanding that temperature can be measured in degrees.

   Students will be expected to:

   6.1 measure temperatures using the Celsius scale
   6.2 perform calculations involving the use of temperature measured in Celsius.

Algebra and Graphing

1. *Students will be expected to* demonstrate an understanding that algebraic expressions can be used to represent situations where one or more values can vary.

   Students will be expected to:

   1.1 write first degree algebraic expressions to illustrate simple mathematical situations with a maximum of two variables
   1.2 evaluate algebraic expressions for replacement values of the variables

      1.2.1 solve problems that involve the evaluation of expressions for values of the variables

   1.3 solve first degree equations in one variable through the use of guess-and-test techniques, concrete manipulatives and formal methods (limit: $x+a=b$, $ax=b$, $ax+b=c$, $\frac{x}{a}=b$)

      1.3.1 solve problems that can be represented by first degree equations in one variable
      1.3.2 use calculators to aid in the solution of equations.

2. *Students will be expected to* demonstrate an understanding that two variables can be related and that those relationships can be expressed by sets of ordered pairs, equations and graphs.

   Students will be expected to:

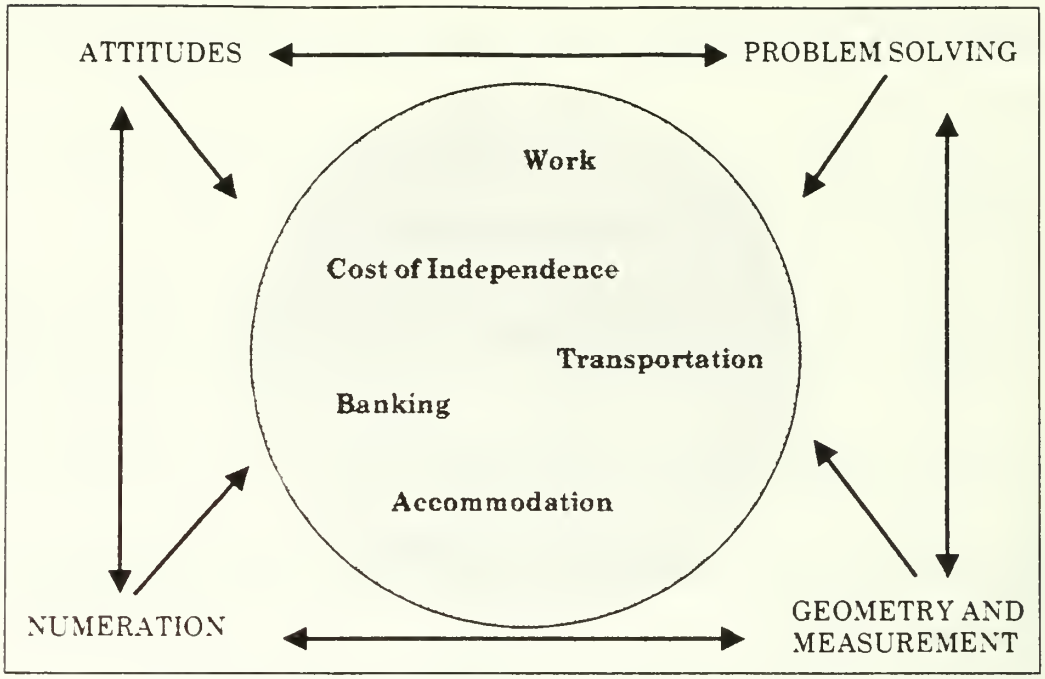
   2.1 describe verbally and in writing the relationships between two variables

      2.1.1 determine the algebraic relationship between two variables by informal means such as guess-and-test

   2.2 plot points on a coordinate plane
   2.3 plot the points and sketch the graphs that describe the relationship between two variables
   2.4 construct tables of values that satisfy given linear equations in two variables
   2.5 sketch graphs from tables of values that satisfy a given linear equation in two variables
   2.6 read and interpret the graphs that describe the relationship between two variables

      2.6.1 analyze graphs that describe the relationship between physical variables by the use of interpolation and extrapolation techniques.

Mathematics 24 Program Structure



Attitudes

1. *Students will be expected to* demonstrate an attitude associated with mathematical literacy. In particular, students will be expected to:

    1.1 be confident in their mathematical knowledge and in their ability to acquire new knowledge
    1.2 demonstrate persistence, resolve, flexibility and ingenuity in finding the solution to problems
    1.3 develop intellectual curiosity and openness to new ideas, insights and change in the pursuit of mathematical knowledge
    1.4 exhibit an attitude of curiosity and spontaneity and appreciate creativity and innovation in representing situations mathematically
    1.5 be critical and constructive in approaching new ideas and new processes
    1.6 be aware of the importance of communication skills in mathematics
    1.7 appreciate the usefulness of computational competence, mathematical processes and problem-solving skills that are used in the decision-making and modeling processes in our society
    1.8 appreciate the contributions of mathematics to our culture and civilization.

Problem Solving

1. *Students will be expected to* demonstrate an understanding of the variety of procedures that can be used to understand problems. In particular, students will be expected to:

    1.1 read the problem thoroughly

1.2 identify and clarify key components
1.3 restate the problem, using familiar terms
1.4 evaluate the given information as to sufficiency and relevancy
1.5 interpret pictures, charts and graphs
1.6 determine hidden assumptions
1.7 ask relevant questions
1.8 identify given, needed and wanted information
1.9 diagram or model the problem situation
1.10 use suitable notation
1.11 determine valid inferences
1.12 simulate a problem situation
1.13 formulate situations into identifiable problems.

2. *Students will be expected to* develop a variety of strategies for use in the solution of mathematical problems. In particular, students will be expected to:

2.1 conduct an investigation
2.2 use estimation and approximation
2.3 develop equations or use formulae
2.4 use flow charts
2.5 make lists and charts
2.6 look for patterns
2.7 work backward
2.8 break the problem into smaller parts
2.9 look for a simpler or related problem
2.10 make diagrams or models
2.11 use manipulatives
2.12 choose and sequence a series of mathematical operations
2.13 sketch the graph of a problem situation
2.14 establish procedures to gather and organize data
2.15 apply empirical or inductive processes
2.16 use geometric construction and measurement techniques
2.17 make and test a conjecture.

3. *Students will be expected to* develop a variety of skills that can be used to carry out the plan for the solution of a problem. In particular, students will be expected to:

3.1 apply selected strategies
3.2 present ideas clearly
3.3 document the solution process
3.4 use appropriate group behaviours
3.5 use calculators and computers
3.6 evaluate problem-solving strategies for effectiveness
3.7 alter or abandon non-productive strategies
3.8 search for additional information
3.9 ask questions
3.10 be open to inspirations, intuitions and "bright ideas".

4. *Students will be expected to* employ a variety of skills to help them look back over the solution of a problem. In particular, students will be expected to:

4.1 determine the reasonableness of an answer

4.2 explain the solution in oral or written form
4.3 consider the possibility of additional solutions
4.4 search for other strategies and processes of solution
4.5 create and solve similar problems
4.6 note the characteristics that will be identifiable in similar problems
4.7 make a generalization
4.8 examine the assumption made and simplifications and modifications used for accuracy, effectiveness and efficiency.

Numeration

Numeration concepts and calculation skills are basic in order to address successfully any mathematical situation. Since it is the intent to integrate the development of these concepts and skills into the other expectations of this course, it is not expected that numeration will be taught as a topic on its own.

1. *Students will be expected to* demonstrate an understanding that computation requires skills in addition, subtraction, multiplication and division with whole numbers, integers and rational numbers and can be done mentally, with paper and pencil, and with electronic calculators, as appropriate to a particular situation.

Mental Computation

Students will be expected to:

1.1 add and subtract whole numbers, integers and rational numbers (limit: add three single-digit integers; subtract two single-digit integers; add and subtract two multiples of 5 and 10 up to 100; add and subtract fractions with common denominators; add and subtract tenths and hundredths written in decimal form)
1.2 multiply whole numbers, integers and rational numbers (limit: single-digit numbers, multiples of 5 and 10 multiplied by a single-digit multiplier; double any number up to 50; multiply whole numbers, integers and decimals by powers of 10)
1.3 square integers up to 10 and calculate square roots of integral perfect squares up to 100
1.4 divide whole numbers, integers and rational numbers (limit: divide integers to 100 which are perfect multiples of single-digit divisors; halve even integers to 50; divide whole numbers, integers and decimals by powers of 10)
1.5 determine whether a whole number or integer is divisible by 2, 3, 4, 5 or 10
1.6 transform fractions to percents (limit: denominators of 2, 3, 4, 5, 10, 100) and whole number percents
1.7 calculate the percent of given whole number quantities (limit: 1%, 10%, 25%, 50%, 100%, 200%)
1.8 recognize "families" of fractions (tenths, twelfths, sixteenths) and transform fractions within families to common denominators.

Paper and Pencil Computation

Students will be expected to:

1.9 add and subtract whole numbers, integers and rational numbers (limit: add three 2-digit integers; subtract 3-digit integers; add and subtract two fractions with denominators of 2, 3, 4, 5, 6, 8, 10, 16; add three 2-digit decimals; subtract 2-digit decimals)

1.10 multiply whole numbers, integers and rational numbers (limit: 2-digit integers, 2-digit decimals, fractions with single-digit denominators and denominators that are multiples of 10)
1.11 divide whole numbers, integers and rational numbers (limit: 3-digit integers which are perfect multiples of single-digit divisors; halve even numbers up to 500)
1.12 calculate the percent of given quantities (limit: 5%, 15%, 25% and multiples of 10%)
1.13 calculate the value of a power (limit: whole number base < 10 and exponent of 2 or 3)
1.14 transform mixed numbers to decimals and percents (limit: denominators of 2, 3, 4, 5, 6, 8, 10).

Calculation with Calculators

Students will be expected to:

1.15 calculate the percent of given quantities
1.16 calculate the value of a power (limit: integral base and whole number exponent)
1.17 calculate the square root of any positive rational number
1.18 transform any rational number to decimal and percent form.

2. *Students will be expected to* demonstrate an understanding that rounding, estimation and approximation are fundamental to facility in calculation.

Students will be expected to:

2.1 round given values to a specified level of precision
2.2 round solutions to an appropriate level of precision
2.3 use estimation techniques to predict solutions to calculations.

3. *Students will be expected to* demonstrate an understanding that checking an answer for reasonableness and accuracy is a fundamental step in the calculation process and that the level of accuracy required is dependent upon the particular situation.

Students will be expected to:

3.1 use estimation techniques to check a calculation for reasonableness
3.2 determine if the accuracy of a calculated answer is adequate for a given situation.

Geometry and Measurement

Understanding of geometric concepts and facility with measurement skills are basic to many mathematical situations faced in life. Since it is the intent to integrate the development of these concepts and skills into the other expectations of this course, it is not expected that geometry and measurement will be taught as topics on their own.

1. *Students will be expected to* demonstrate an understanding that geometric shapes and solids have mathematical attributes.

Students will be expected to:

1.1 make scale drawings and models of geometric shapes and solids
1.2 use the geometric properties of angles and lines to determine the properties and measurements of shapes and solids.

2. *Students will be expected to* demonstrate an understanding that geometric shapes and solids can be measured directly and indirectly using various techniques, instruments and units, and that the accuracy of any measurement is dependent upon the instrument being used, the individual doing the measurement and the need for precision.

   Students will be expected to:

   2.1 measure length, angle, area, volume, capacity and mass using appropriate instruments
   2.2 determine approximate measurements from scale drawings or maps
   2.3 determine the accuracy of a measurement based on the need and the instruments used
   2.4 determine the proper precision for an approximated or ascertained measurement
   2.5 use formulas for perimeter, area and volume to measure indirectly regular geometric shapes and solids
   2.6 use procedures based on known formulas to measure indirectly irregular geometric shapes and solids.

Work - Income

1. *Students will be expected to* demonstrate an understanding that pay received for work done can be calculated and that the deductions from gross pay can be determined.

   Students will be expected to:

   1.1 calculate gross wages based on a regular hourly rate and overtime hourly rate as well as other pay methods, including weekly and monthly salaries, piecework, bonuses, commissions and combinations of methods
   1.2 calculate net weekly, biweekly or monthly wages, considering deductions such as unemployment insurance, retirement pensions, Canada Pension Plan, medical insurance, disability insurance and income tax

      1.2.1 compare the financial advantages between jobs in which the worker gets no benefits other than wages and those in which benefits are provided

   1.3 calculate gross and net annual earnings, given various pay methods
   1.4 calculate weekly, biweekly and monthly earnings, given annual earnings.

Work - Income Tax

1. *Students will be expected to* demonstrate an understanding that income tax will be paid by all workers and that the amount paid will depend upon a number of factors.

   Students will be expected to:

   1.1 collect and interpret records of employment income
   1.2 determine and calculate allowable deductions from income

      1.2.1 determine the effect of discretionary deductions on total tax paid

   1.3 complete an appropriate Revenue Canada taxation form.

Banking - Personal Banking

1. *Students will be expected to* demonstrate an understanding that savings and chequing accounts with banks and other financial institutions are services that consumers can use to help manage their money.

   Students will be expected to:

   1.1 identify and compare types and purposes of accounts
   1.2 deposit and withdraw funds
   1.3 verify an account statement against records of deposit and withdrawal and reconcile chequing account statements

      1.3.1 compare the costs of various banking services and determine the advantages and disadvantages of maintaining particular types of accounts

   1.4 calculate simple interest for periods involving days, months and years
   1.5 calculate compound interest

      1.5.1 use a calculator to calculate compound interest over a maximum of four compound periods
      1.5.2 use simple tables or a computer to calculate compound interest for more than four compound interest periods
      1.5.3 compare simple and compound investment earnings amongst various forms of savings plans including types of savings accounts, guaranteed investment certificates and other bank-centred savings plans.

Banking - Consumer Credit

1. *Students will be expected to* demonstrate an understanding that borrowing money is a consumer activity in which the use of someone else's money is bought and that the price is interest paid on the principle borrowed.

   Students will be expected to:

   1.1 identify types and characteristics of loans such as consumer loans, car loans and consolidation loans

      1.1.1 compare actual costs of borrowing between different companies and different types of loans

   1.2 calculate the periodic payments for loans using tables
   1.3 calculate the total amount to be repaid, including interest, given various types of loans and loan characteristics.

2. *Students will be expected to* demonstrate an understanding that credit cards provide consumers with instant loans.

   Students will be expected to:

   2.1 read, interpret and calculate the information on credit card sales drafts and monthly statements
   2.2 calculate the interest charge due on a credit card balance

2.3 calculate the service charges associated with using credit cards, including membership charges, yearly fees and transaction fees
2.4 calculate the actual time required and total cost to pay off a credit card balance by paying only the minimum payment.

Transportation - Purchasing a Vehicle

1. *Students will be expected to* demonstrate an understanding of the costs associated with purchasing a motor vehicle.

   Students will be expected to:

   1.1 calculate the fair price of a vehicle given age, condition, mileage and options

      1.1.1 determine the total costs expected (such as down payment, repairs, insurance, etc.) upon purchase of a vehicle

   1.2 determine the monthly payments for installment purchases

      1.2.1 compare the costs of various payment options which may be available for the purchase or lease of a vehicle.

Transportation - Operating a Vehicle

1. *Students will be expected to* demonstrate an understanding of the costs associated with operating a motor vehicle.

   Students will be expected to:

   1.1 calculate the costs associated with owning a vehicle, including monthly payments, insurance, gasoline, and maintenance costs
   1.2 calculate the cost of vehicle insurance given factors such as type and age of vehicle, age, gender and driving record of insured
   1.3 calculate the fuel economy of a vehicle as rate of consumption per 100 km
   1.4 calculate the cost of gasoline for travelling a given distance
   1.5 determine the depreciation of a vehicle over time
   1.6 calculate the total costs of owning and operating a vehicle over a period of time

      1.6.1 examine the costs, advantages and disadvantages associated with alternatives to owning a motor vehicle, such as using public transit, taxicabs, riding a bicycle, etc.

Transportation - Travelling

1. *Students will be expected to* demonstrate an understanding of the costs associated with travelling.

   Students will be expected to:

   1.1 calculate the costs of accommodation and meals based on the location, length of trip, length of stay, type of meal plan and gratuities
   1.2 estimate the costs of automobile travel, including fuel, maintenance, accommodation and meals en route, and compare the costs to other modes of travel

1.3 estimate the total distances travelled using maps and mileage charts
1.4 estimate miscellaneous costs such as entertainment, excursions, gratuities, health insurance and travel insurance
1.5 calculate the costs associated with travellers cheques and conversions between currencies
1.6 compare the costs of package vacations with the estimated costs of individually arranged vacations.

Accommodation - Renting and Purchasing

1. *Students will be expected to* demonstrate an understanding that renting and purchasing a residence are two options with different responsibilities, advantages and costs.

   Students will be expected to:

   1.1 investigate the costs of renting given various conditions such as location, type of building, size and amenities
   1.2 estimate the monthly costs associated with renting a residence, including rent, parking, insurance and other fixed costs and utilities, and other variable costs
   1.3 investigate the purchase price of a residence, given various conditions such as the type of housing, location, amenities and size
   1.4 calculate the costs and fees associated with purchasing a residence
   1.5 estimate and calculate the monthly costs associated with home ownership, including mortgage payments, taxes, utilities, insurance and maintenance
   1.6 calculate the costs and fees associated with moving into a residence, such as moving, utility hook-ups and security deposit
   1.7 estimate and calculate the costs of furnishing and supplying a rental accommodation
   1.8 compare the relative costs and advantages between owning and renting property.

Accommodation - Mortgages and Household Insurance

1. *Students will be expected to* demonstrate an understanding that a mortgage is a loan used to purchase a residence.

   Students will be expected to:

   1.1 define mortgage and distinguish between mortgage types and options
   1.2 calculate mortgage payments using amortization tables for various terms and conditions

      1.2.1 compare the costs of mortgage payments given various terms and payment options

   1.3 calculate the total cost of purchasing real estate over the entire length of the amortization period

      1.3.1 compare the total costs of several payment plans

   1.4 estimate and calculate the regular payment made on a residence if it is comprised of principle, interest and taxes.

2. *Students will be expected to* demonstrate an understanding that household insurance is protection purchased from a company to cover losses incurred to a residence or its contents.

Students will be expected to:

2.1 examine types of household insurance policies and the purposes and advantages of each
2.2 calculate the costs of insurance based on various factors including types of coverage, location, property value, type of construction, availability of fire protection, amount of deductible and limits of liability.

Accommodation - Building, Decorating and Furnishing

1. *Students will be expected to* demonstrate an understanding that the approximate cost of building a new house can be determined through estimations based on known measures and costs.

   Students will be expected to:

   1.1 make a scale drawing of a house and a lot
   1.2 use the local building code ratios between the size of the foundation, house and lot to determine the allowable size of the house
   1.3 estimate the total cost of building a house based on estimated costs per square metre

      1.3.1 compare the costs of building a house using various combinations and qualities of building materials.

2. *Students will be expected to* demonstrate an understanding that a residence can be represented by a scale drawing, which can then be measured and used for various purposes.

   Students will be expected to:

   2.1 make a scale drawing of a house, apartment or room to be decorated and furnished
   2.2 calculate the surface areas (floors, ceilings, walls) to be decorated
   2.3 calculate the costs of floor, window and wall coverings and the total costs

      2.3.1 perform an investigation to determine the costs of redecorating an entire residence

   2.4 calculate the costs of furnishings and appliances.

Cost of Independence - Budgets and Getting Value for Money Spent

1. *Students will be expected to* demonstrate an understanding that a personal budget is useful in order to maintain records of expenditure and to plan for the future.

   Students will be expected to:

   1.1 record estimated earnings and expenses
   1.2 calculate individual expenses as percents of total expenses
   1.3 design and balance a personal budget.

2. *Students will be expected to* demonstrate an understanding that consumers can obtain the best value for their money by the application of some wise spending practices.

   Students will be expected to:

   2.1 calculate and compare the unit costs of items

2.2 calculate the sale price of an item given the list or regular price and the discount
2.3 calculate the rate of discount given the regular and the sale prices
2.4 calculate the regular price given the sale price and the rate of discount
2.5 calculate the sales tax on purchases.

Cost of Independence - Life and Health Insurance

1. *Students will be expected to* demonstrate an understanding that life insurance is a way to provide financial protection for dependents in case of death.

   Students will be expected to:

   1.1 identify, compare and discuss features of types of life insurance such as term, whole-life, endowment and group
   1.2 calculate premiums for life insurance coverage given factors such as amount of insurance, age, gender, health, employment, lifestyle and leisure activities
   1.3 identify and examine company projections of life insurance values, including dividends, over the life of a policy
   1.4 calculate the costs and benefits of health insurance given various types of coverage
   1.5 calculate the costs and benefits of disability insurance.

D. BASIC LEARNING RESOURCES

Mathematics 14

Price, Jack, Olene Brame, Michael Charles, and Miriam Clifford. *Applications of Mathematics.* Weston, Ontario: Merrill Publishing, 1989.

Mathematics 24

Bolster, L. Carey, H. Douglas Woodburn, and Joella H. Gipson. *Consumer and Career Mathematics, Second Canadian Edition.* Gage Educational Publishing Company, 1991.

Lange, Walter H., Robert D. Mason, and Temoleon G. Rousos. *Consumer Mathematics.* Markham, Ontario: Houghton Mifflin Company Ltd., 1985.

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